[10191/3600]

IN THE UNITED STATES PATENT AND TRADEMARK OFFICE
BOARD OF PATENT APPEALS AND INTERFERENCES

In re Application of:	Hans-Martin WIEDENMANN et al.
Serial No.:	10/510,397
Filed:	July 14, 2005
For:	METHOD FOR OPERATING A BROADBAND LAMBDA SENSOR
Examiner:	Kourtney R. Salzman
Art Unit:	1795
Confirmation No.:	3134

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Signature: /Kevin Kambo/
Kevin Kambo

APPEAL BRIEF PURSUANT TO 37 C.F.R. § 41.37

SIR:

On September 10, 2009, Appellants filed a Notice of Appeal from the last decision of the Examiner contained in the Final Office Action dated May 11, 2009 in the above-identified patent application.

In accordance with 37 C.F.R. § 41.37, this brief is submitted in support of the appeal of the rejection of claims 8 to 21. For at least the reasons set forth below, the rejection of claims 8 to 21 should be reversed.

1. REAL PARTY IN INTEREST

The real party in interest in the present appeal is ROBERT BOSCH GMBH of Stuttgart in the Federal Republic of Germany, which is the assignee of the entire right, title and interest in and to the present application.

2. RELATED APPEALS AND INTERFERENCES

There are no other prior or pending appeals, interferences or judicial proceedings known by the undersigned, or believed by the undersigned to be known to Appellants or the assignee, ROBERT BOSCH GMBH, "which may be related to, directly affect or be directly affected by or have a bearing on the Board's decision in the pending appeal."

3. STATUS OF CLAIMS

Claims 8 to 21 are pending.

Claims 1 to 7 have been canceled.

Claims 8 to 21 stand rejected under 35 U.S.C. § 103(a) as unpatentable over the combination of DE 198 38 466 ("Lenfers et al.") and U.S. Patent No. 3,949,551 ("Eichler et al.").

A copy of the appealed claims, *i.e.*, claims 8 to 21, is attached hereto in the Claims Appendix.

4. STATUS OF AMENDMENTS

In response to the Final Office Action dated May 11, 2009, Appellants filed a "Response After Final" ("the Response") on July 13, 2009. No proposed amendments to the claims were included in the Response. It is Appellants' understanding that the claims as included in the annexed "Claims Appendix" reflect the current claims.

5. SUMMARY OF THE CLAIMED SUBJECT MATTER

The appealed claims contain one (1) independent claim, *i.e.*, claim 8.

Independent claim 8 relates to a method for operating a broadband lambda sensor (10) for determining an oxygen concentration in the exhaust gas of an internal combustion engine (31) operated with a fuel-air mixture. *Specification* at page 1, lines 3 to 6. According to claim 8, the lambda sensor (10) has a Nernst cell (11) that has a measurement electrode (12) and a reference electrode (13). *Specification* at page 5, lines 13 to 16; Figure

1. According to claim 8, the reference electrode (13) is exposed to a reference gas in a reference canal (15). *Specification* at page 5, lines 24 to 25; Figure 1. According to claim 8, the lambda sensor (10) also has a pump cell (16) that has an outer electrode (18) exposed to the exhaust gas and an inner electrode (17) situated with the measurement electrode (12) in a measurement chamber (20). *Specification* at page 5, lines 26 to 32; Figure 1. According to claim 8, the measurement chamber (20) is separated from the exhaust gas by a diffusion barrier (21). *Id*. Claim 8 recites that the method includes applying a pump voltage (U_P) to the pump cell (16), the pump voltage (U_P) being set dependent on a Nernst voltage (U_N) that is present at the Nernst cell (11) and that corresponds to the oxygen concentration in the measurement chamber (20). *Specification* at page 6, lines 26 to 31; Figure 1. Claim 8 recites driving, dependent on the oxygen content of the exhaust gas, one of a cathodic and anodic pump current (I_P) via the pump cell (16). *Specification* at page 6, line 29 to page 7, line 8. According to claim 8, the pump current (I_P) is cathodic during a lean operation, the lean operation being defined as a stable operation of the internal combustion engine (31) with a fuel-air mixture in a lean range, and wherein the pump current (I_P) is anodic during a rich operation, the rich operation being defined as a stable operation of the internal combustion engine (31) with a fuel-air mixture in a rich range. *Id*. Claim 8 recites repeatedly reversing the polarity of the pump voltage (U_P) during at least the lean operation to create a temporary reversal of direction of the pump current (I_P). *Specification* at page 8, lines 4 to 9; Figures 2 to 5. According to claim 8, the repeated reversal of polarity of the pump voltage (U_P) is carried out at least one of during the duration of a secondary fuel injection in the lean operation of the internal combustion engine (31) and during a warm-up phase of the lambda sensor (10). *Specification* at page 10, lines 10 to 19; Figures 2 to 5.

6. <u>GROUND OF REJECTION TO BE REVIEWED ON APPEAL</u>

The ground of rejection to be reviewed on appeal is whether claims 8 to 21 are unpatentable, under 35 U.S.C. § 103(a), over the combination of Lenfers et al. and Eichler et al.

7. <u>ARGUMENTS</u>

Claims 8 to 21 stand rejected under 35 U.S.C. § 103(a) as unpatentable over the combination of Lenfers et al. and Eichler et al. It is respectfully submitted that the combination of Lenfers et al. and Eichler et al. does not render unpatentable these claims for at least the following reasons.

Claim 8 relates to a method for operating a broadband lambda sensor for determining an oxygen concentration in the exhaust gas of an internal combustion engine operated with a fuel-air mixture, and recites, *inter alia*, that the method includes repeatedly reversing the polarity of the pump voltage during at least the lean operation to create a temporary reversal of direction of the pump current, wherein the repeated reversal of polarity of the pump voltage is carried out at least one of during the duration of a secondary fuel injection in the lean operation of the internal combustion engine and during a warm-up phase of the lambda sensor.

The combination of Lenfers et al. and Eichler et al. does not disclose or even suggest all of these features. Lenfers et al. relate to a method for operating a broadband lambda sensor (10), which after a long period of lean operation of the lambda sensor (10), a switching device (54) causes a pulse-like reversal of pump current, which breaks down a polarization effect at the lambda sensor (10), compensating for rich drift, and preventing any inaccuracy in the measurement value. Eichler et al. relate to a method and system to reduce the noxious components in the exhaust gases during the warm-up period of the internal combustion engine.

The Final Office Action, on page 4, admits that "Lenfers et al fails to teach the engine to be in lean condition during the warm-up phase or during the duration of a secondary fuel injection," but points to Eichler et al. as allegedly disclosing "the sensor to be in the lean phase during warm up." In this regard, the Final Office Action, on page 5, contends that "it would have been obvious to one possessing ordinary skill in the art at the time the invention was being made to also utilize these pulses during other extended periods of lean operation, such as the during an initial warm-up lean operation like shown by Eichler, so as to prevent the polarization of the electrodes during these other lean operations as well."

However, this modification to use Lenfers et al. with Eichler et al. to prevent rich drift through reversal of polarity during short-term lean operation, would have been unpredictable based on the disclosures of the relied upon references. This is because Lenfers et al., while disclosing reversal of polarity, does not disclose short term operation or the warm up phase. Eichler et al., while referring to the warm up phase, does not mention long term or short term operation. According to the Examiner, in the Advisory Action, Lenfers et al. and Eichler et al. are combinable since rich drift can occur in both short term and long term operation.

While it may be possible that rich drift could occur in both short term and long term operation (which is not conceded), Lenfers et al. ***merely*** refer to elimination or

compensation of the rich drift ***after a long period of time***, and not during a short period of time or during short term lean operation. For example, when referring to the prior art, Lenfers et al. state that "[o]ne disadvantage…is that if the internal combustion engine operates under lean conditions for a ***long period of time, e.g., several hours***…the sensor is subject to a rich drift leading to inaccuracies in the output signal." (column 1, line 57 to column 2, line 5, *emphasis added*). Further, Lenfers et al. state, in column 2, lines 12 to 13, "after a selectable period of time during which sensor operation has been exclusively lean," rich drift can be compensated, and in column 3, lines 53 to 55, that "it is assumed that the fuel-air mixture with which the internal combustion engine is operated is in a lean range for a ***long period of time***," and in column 4, lines 54 to 56, that "on the whole, the rich drift during ***long-term lean operation*** is eliminated by brief, defined rich operation of sensor 10" (*emphasis added*). Nowhere, do Lenfers et al. refer to compensation of rich drift during a short period of time or during short term lean operation. While Lenfers et al. in combination with Eichler et al. may result in preventing inaccuracies in the measurement value during long term lean operation, there is no indication that inaccuracies in the measurement value due to polarization effect at the lambda sensor during short term lean operation could be prevented. Thus, the suggested modification necessarily relies on improper hindsight reasoning based on Applicants' disclosure.

Furthermore, in the Response to Arguments section of the Final Office Action, the Examiner asserts that "there is no indication that it would be beneficial to not apply the polarity reversals in any condition of lean operation because at any point the rich drift can begin to take effect and skew the concentration readings." While there may be *no* indication to *not* apply polarity reversal to short term lean operation, there is also no indication *to* apply polarity reversal to short term lean operation, as mentioned above. Carrying out ***repeated*** reversal of polarity of the pump voltage, in ***short*** term lean operation, has not been contemplated by the prior art, so that any such suggestion is necessarily based on improper hindsight reasoning based on Applicants' disclosure.

Moreover, the Examiner has ***not provided any support for the proposition that there was a reasonable expectation of success*** for modifying the features of Lenfers et al. to apply repeated reversals of polarity to short term lean operation. For example, the present application discloses that the reversal of polarity that is repeatedly carried out "ensures that due to the repeated short-term anodic loading of the inner electrode of the pump cell, oxygen ions are pumped into the measurement chamber, where they oxidize the hydrocarbons. If the repetition rate of the reversal of polarity of the pump voltage is selected

to be high enough, the dynamic characteristic of the sensor is not altered. At a sufficiently high electrode temperature, the oxygen transport can effectively follow the pump frequency, and the catalysis of the hydrocarbon conversion is improved." (Page 3, lines 10 to 20). The cited art does not contemplate the application of repeated reversal of polarity of the pump voltage to short term lean operation.

For all of the foregoing reasons, the combination of Lenfers et al. and Eichler et al. does not disclose or suggest all of the features of claim 8. As for claims 9 to 21, which ultimately depend from claim 8 and therefore include all of the features included in claim 8, it is respectfully submitted that the combination of Lenfers et al. and Eichler et al. does not render unpatentable these dependent claims for at least the reasons more fully set forth above in support of the patentability of claim 8.

In view of all of the foregoing, reversal of this rejection is respectfully requested.

8. CLAIMS APPENDIX

A "Claims Appendix" is attached hereto and appears on the two (2) pages numbered "Claims Appendix 1" and "Claims Appendix 2."

9. EVIDENCE APPENDIX

No evidence has been submitted pursuant to 37 C.F.R. §§ 1.130, 1.131 or 1.132. No other evidence has been entered by the Examiner or relied upon by Appellants in the appeal. An "Evidence Appendix" is nevertheless attached hereto and appears on the one (1) page numbered "Evidence Appendix."

10. RELATED PROCEEDINGS APPENDIX

As indicated above in Section 2, "[t]here are no other prior or pending appeals, interferences or judicial proceedings known by the undersigned, or believed by the undersigned to be known to Appellants or the assignee, ROBERT BOSCH GMBH, 'which may be related to, directly affect or be directly affected by or have a bearing on the Board's decision in the pending appeal.'" As such, there are no "decisions rendered by a court or the Board in any proceeding identified pursuant to [37 C.F.R. § 41.37(c)(1)(ii)]" to be submitted. A "Related Proceedings Appendix" is nevertheless attached hereto and appears on the one (1) page numbered "Related Proceedings Appendix."

11. CONCLUSION

For at least the reasons indicated above, Appellants respectfully submit that the art of record does not disclose or suggest the subject matter as recited in the claims of the above-identified application. Accordingly, it is respectfully submitted that the subject matter as set forth in the claims of the present application is patentable.

In view of all of the foregoing, reversal of the rejection set forth in the Final Office Action is therefore respectfully requested.

Respectfully submitted,

/Clifford A. Ulrich/

Dated: January 7, 2010

By: Clifford A. Ulrich (Reg. No. 42,194) for
Gerard A. Messina (Reg. No. 35,952)

KENYON & KENYON LLP
One Broadway
New York, New York 10004
(212) 425-7200
CUSTOMER NO. 26646

CLAIMS APPENDIX

8. A method for operating a broadband lambda sensor for determining an oxygen concentration in the exhaust gas of an internal combustion engine operated with a fuel-air mixture, the lambda sensor having a Nernst cell that has a measurement electrode and a reference electrode, the reference electrode being exposed to a reference gas in a reference canal, the lambda sensor also having a pump cell that has an outer electrode exposed to the exhaust gas and an inner electrode situated with the measurement electrode in a measurement chamber, the measurement chamber being separated from the exhaust gas by a diffusion barrier, the method comprising:

applying a pump voltage to the pump cell, the pump voltage being set dependent on a Nernst voltage that is present at the Nernst cell and that corresponds to the oxygen concentration in the measurement chamber;

driving, dependent on the oxygen content of the exhaust gas, one of a cathodic and anodic pump current via the pump cell, wherein the pump current is cathodic during a lean operation, the lean operation being defined as a stable operation of the internal combustion engine with a fuel-air mixture in a lean range, and wherein the pump current is anodic during a rich operation, the rich operation being defined as a stable operation of the internal combustion engine with a fuel-air mixture in a rich range; and

repeatedly reversing the polarity of the pump voltage during at least the lean operation to create a temporary reversal of direction of the pump current, wherein the repeated reversal of polarity of the pump voltage is carried out at least one of during the duration of a secondary fuel injection in the lean operation of the internal combustion engine and during a warm-up phase of the lambda sensor.

9. The method according to claim 8, wherein, for the repeated reversal of polarity of the pump voltage, a sequence of voltage pulses having a constant amplitude is applied to the pump cell, and an effective pump current is set by pulse width modulation of the voltage pulses dependent on the Nernst voltage of the Nernst cell.

10. The method according to claim 8, wherein, for the repeated reversal of polarity of the pump voltage, a sequence of voltage pulses having a constant pulse width is applied to the pump cell, and an effective pump current is set by modifying amplitudes of the voltage pulses dependent on the Nernst voltage of the Nernst cell.

11. The method according to claim 9, wherein the frequency of the sequence of the voltage pulses is between 10 Hz to 2000 Hz.

12. The method according to claim 11, wherein the frequency of the sequence of the voltage pulses is approximately 500 Hz.

13. The method according to claim 10, wherein the frequency of the sequence of the voltage pulses is between 10 Hz to 2000 Hz.

14. The method according to claim 13, wherein the frequency of the sequence of the voltage pulses is approximately 500 Hz.

15. The method according to claim 9, wherein the frequency of the sequence of the voltage pulses is equal to a call rate of a lambda signal for setting the fuel-air mixture of the internal combustion engine.

16. The method according to claim 10, wherein the frequency of the sequence of the voltage pulses is equal to a call rate of a lambda signal for setting the fuel-air mixture of the internal combustion engine.

17. The method according to claim 8, wherein an operating temperature of the lambda sensor is increased for at least one of duration of the secondary injection and duration of the warmup phase of the lambda sensor.

18. The method according to claim 9, wherein an operating temperature of the lambda sensor is increased for at least one of duration of the secondary injection and duration of the warmup phase of the lambda sensor.

19. The method according to claim 10, wherein an operating temperature of the lambda sensor is increased for at least one of duration of the secondary injection and duration of the warmup phase of the lambda sensor.

20. The method according to claim 9, wherein the application of the sequence of the voltage pulses to the pump cell is maintained continually in lean and rich operation of the internal combustion engine.

21. The method according to claim 10, wherein the application of the sequence of the voltage pulses to the pump cell is maintained continually in lean and rich operation of the internal combustion engine.

EVIDENCE APPENDIX

No evidence has been submitted pursuant to 37 C.F.R. §§1.130, 1.131, or 1.132. No other evidence has been entered by the Examiner or relied upon by Appellants in the appeal.

RELATED PROCEEDINGS APPENDIX

As indicated above in Section 2 of this Appeal Brief, "[t]here are no other prior or pending appeals, interferences or judicial proceedings known by the undersigned, or believed by the undersigned to be known to Appellants or the assignee, ROBERT BOSCH GMBH, 'which may be related to, directly affect or be directly affected by or have a bearing on the Board's decision in the pending appeal.'" As such, there are no "decisions rendered by a court or the Board in any proceeding identified pursuant to [37 C.F.R. § 41.37(c)(1)(ii)]" to be submitted.